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Docket No. 87354.2761
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES
APPEAL BRIEF FOR THE APPELLANTS
Ex parte Rendahl et al.

Applicant: Craig S. RENDAHL, et al.	)	
	)	
Application No. 10/075,389	)	Art Unit: 2863
	)	
Filed: February 15, 2002	)	Examiner: Kamini S. Shah
	)	

For: METHOD AND SYSTEM FOR DETECTION OF HYDROCARBON SPECIES IN A GAS

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith are three copies (3) of an Appeal Brief and a check for the official fee for the Appeal Brief, in the amount of Three Hundred and Thirty Dollars ($330.00). The brief is due on March 6, 2004. Please charge any fee deficiencies or credit any overpayments to Deposit Account No. 50-2036.

Respectfully submitted,

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Application No. 09/502,680	)	Art Unit: 2863
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For: METHOD AND SYSTEM FOR DETECTION OF HYDROCARBON SPECIES IN A GAS

BRIEF ON APPEAL

I. INTRODUCTION

This is an appeal from the final Office Action dated October 6, 2003. A Notice of Appeal was filed on January 6, 2004. An Appeal Brief is due by March 6, 2004.

II. REAL PARTY IN INTEREST

The Real Party in Interest in the present application is SPX Corporation by way of an assignment.

III. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to the appellants, appellants' representatives or assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

IV. STATUS OF THE CLAIMS

Claims 1-22 are pending in the application. Claims 1-22 stand rejected under 35 U.S.C. §103 as being unpatentable over Didomenico et al. (U.S. Patent No. 6,307,201) in view of Addiego (U.S. Patent No. 6,109,095).

V. STATUS OF THE AMENDMENTS

The claims submitted on February 15, 2002 were rejected under 35 U.S.C. §103 in an Office Action dated April 15, 2003. A response to the Office Action dated April 15, 2003 was submitted on July 15, 2003 arguing the patentability of the claims over the combination of Didomenico and Addiego. No amendments to the claims were made. A final Office Action dated October 6, 2003 was issued rejecting the claims.

VI. SUMMARY OF THE INVENTION

A. Related Art Problems Overcome by the Invention

Current open path analysis systems determine the total hydrocarbon concentration by measuring the infrared absorption in the single carbon-hydrogen bond-stretching region. Typically, propane gas is used for calibration. However, some important exhaust species such as benzene and acetylene do not have any single carbon-hydrogen bonds. These species do not absorb in the same infrared region and thus are not measured by the current art open path emissions sensors. In addition, other aromatic and alkene species have only a few alkane groups and absorb less infrared energy than the propane standard. Consequently the current remote

sensing technology generally underestimates the total hydrocarbon concentration by about fifty percent. Another problem with the current technology is water vapor interference, which especially occurs at 30 to 50 degrees Fahrenheit. Still another issue with the current art is that there is no means for correcting a gas emissions measurement for changes in ambient temperature and pressure through the sample path.

B. Object of the invention

Since water may interfere with individual HC measurements, especially alkene and alkyne group measurements, a check must be made to determine whether the THC measurement is indeed HC or if there is a significant water interference (FIG. 1, step 22). The invention of the present application determines the omni-state of water interference, which means that the interference for a given state of water is determined. For example, the invention in one embodiment measures and detects water (liquid and vapor states) (FIG. 1, step 11), measures (FIG. 1, step 11) or implies (FIG. 1, step 22) detection of ice droplets in the HC sample, and flags and/or reports THC measurements that may be affected by liquid water contamination (FIG. 1, step 28) and/or reports a validated THC measurement (FIG. 1, step 26).

Wavelengths within the mid-infrared region that have interferences minimized are used to measure water vapor, though CO_2 can interfere at the 2.75μ wavelength for open path systems in particular.

Typical vehicle exhaust will have approximately 20% water vapor content, and is a consequence of ideal combustion. What is important is what happens to the water vapor as it exits the exhaust system of a vehicle. Water vapor can condense into liquid water droplets and

therefore interfere with HC species measurement. Alternatively, water vapor can sublimate into ice crystals also interfering with the detection of HC species.

Omni-state water interference detection/interpretation will reduce the number of erroneously high hydrocarbon measurements that are caused by liquid water interference. The liquid water interference is detected in part from ambient sensors, including a temperature sensor, pressure sensor, and/or relative humidity sensor (FIG. 1, step 12), in combination with taking a water vapor measurement of the sample of HC gases (FIG. 1, step 11). For example, liquid water interference is common if ambient temperatures are in the range of approximately 30 to 50 degrees Fahrenheit, or if ambient humidity is relatively high. Also, a vehicle that has not sufficiently warmed up can also emit excess water vapor, hence the desire for some means of measuring water vapor content (FIG. 1, step 11) in the exhaust sample. The system may therefore measure omni-state water interference (e.g. water in various states of matter) when such cool ambient conditions are present and measured in conjunction with water contamination emitted coincident with the HC species in tailpipe exhaust.

C. The claimed invention

1. Independent Claim 1

Claim 1 is a method of measuring hydrocarbon content in a gas. The method includes the step of measuring a plurality of individual hydrocarbon concentrations in a gas sample (FIG. 1, step 10, and page 7, lines 3-19 of the present application). A total concentration is determined based on the plurality of individual concentrations. The method also includes identifying an occurrence of water interference in the gas sample (FIG. 1, step 22 of the present application), and determining whether the occurrence of

water interference exceed an interference level (FIG. 1, step 24 and paragraph 18 of the present application).

2. Dependent Claims 2-10

Claim 2 is dependent on claim 1 and further defines the first determining step as including the steps of grouping the individual hydrocarbon concentrations into a plurality of classes; summing the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and adding the class concentrations to yield the total concentration.

Claim 3 is dependent on claim 1 ad further defines the second step as determining when the amount of an occurrence of water interference exceeds an interference level, and comprising the additional step of relating the total concentration to water contamination.

Claim 4 is dependent on claim 1 and further defines the second determining step as determining whether an omni-state of water amount exceeds an interference level, and further comprising the step of reporting at least one state of matter of water interference condition.

Claim 5 is dependent on claim 1 and further defines the measuring step as including the step of using an open path emission sensor to detect the intensity of a plurality of infrared spectra in the gas sample.

Claim 6 is dependent on claim 1 and further defines the measuring step as including measuring by at least one of non-dispersive infrared detection, dispersive

infrared detection, non-dispersive ultraviolet detection, dispersive ultraviolet detection, tunable diode laser, non-dispersive visible detection and dispersive visible detection.

Claim 7 is dependent on claim 1 and further defines the measuring step as including measuring by at least one of differential optical absorption detection and gas filter correlation detection.

Claim 8 is dependent on claim 1 and further includes the additional step of scaling the total concentration to account for optical overlap of individual hydrocarbon species.

Claim 9 is dependent on claim 1 and further includes the additional step of adjusting at least one of the individual hydrocarbon and CO2 concentrations to account for one or more ambient conditions.

Claim 10 is dependent on claim 1 and further includes the additional step of adjusting the total hydrocarbon concentration to account for one or more ambient conditions.

3. Independent Claim 11

Claim 11 is a system for measuring hydrocarbon content in a gas. The system includes an emissions sensor capable of detecting a plurality of individual hydrocarbons in a gas sample; a processor in communication with the emissions sensor; and a computer-readable carrier in communication with the processor. The computer-readable carrier contains program instructions that instruct the processor to perform the steps of: receiving data corresponding to a plurality of individual hydrocarbon concentrations in a sample; determining a total concentration based on the plurality of individual concentrations; measuring an occurrence of water interference in the gas sample; and

determining whether the occurrence of water interference corresponds to an interference condition.

4. Dependent Claims 12 -18

Claim 12 is dependent on claim 11 and further defines the emissions sensor as including an open path emissions sensor or a closed path emissions sensor.

Claim 13 is dependent on 11 and further defines the program instructions that instruct the processor to perform the first determining step as including instructions to group the individual hydrocarbon concentrations into a plurality of classes; sum the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and add the class concentrations to yield the total concentration.

Claim 14 is dependent on claim 11 and defines the invention as further including an ambient condition sensor that receives ambient condition data.

Claim 15 is dependent on claim 14 and defines the program instructions as including instruction to instruct the processor to adjust the total concentration in response to the ambient condition data.

Claim 16 is dependent on claim 11 and further includes a transmitter that is capable of transmitting data corresponding to the total concentration.

Claim 17 is dependent on claim 11 and further defines the emissions sensor and the processor as being linked by a communications link that allows data corresponding to a plurality of individual hydrocarbon concentrations to be transmitted by the emissions sensor to the processor via the communications link.

Claim 18 is dependent on claim 11 and further defines the program instructions as further instructing the processor to, when an omni-state of water occurrence corresponds to an interference condition, relate the total concentration to at least one state of matter of water interference contamination.

5. Independent Claim 19

Claim 19 is a system for measuring hydrocarbon content in a gas. The system includes a means for detecting a plurality of individual hydrocarbons in a gas sample; a means for determining a total concentration based on the plurality of individual concentrations; a means for identifying an occurrence of water interference in the gas sample; and a means for determining whether said occurrence of water interference correspond to an interference condition.

6. Dependent Claims 20-22

Claim 20 is dependent on claim 19 and further defines the means for determining a total concentration as including a means for grouping the individual hydrocarbon concentrations into a plurality of classes; a means for summing the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and a means for adding the class concentrations to yield the total concentration.

Claim 21 is dependent on claim 19 and further includes a means for detecting one or more ambient conditions; and a means for adjusting gas measurements to account for one or more ambient conditions.

Claim 22 is dependent on claim 19 and further includes a means for scaling gas measurements to account for multiple counting of individual hydrocarbon species; a means for adjusting at least one of the individual hydrocarbon and CO2 concentrations to account for one or more ambient conditions; and a means for adjusting the total hydrocarbon concentration to account for one or more ambient conditions.

VII. ISSUES

Whether claims 1-22 are unpatentable over Didomenico et al. (U.S. Patent No. 6,307,201) in view of Addiego (U.S. Patent No. 6,109,095) under 35 U.S.C. §103.

VIII. GROUPING OF CLAIMS

Each claim of this patent application is separately patentable, and upon issuance of a patent, will be entitled to a separate presumption of validity under 35 U.S.C. §282.

IX. APPELLANTS ARGUMENTS

Rejection of claims 1-22 under 35 U.S.C. §103 as being unpatentable over Didomenico et al. (U.S. Patent No. 6,307,201) in view of Addiego (U.S. Patent No. 6,109,095).

Claims 1-22 were rejected under 35 U.S.C. §103 as being unpatentable over Didomenico et al. in view of Addiego. The following is stated in the outstanding Office Action:

> Regarding to claimed invention, Didomenico et al discloses the detector 16 which convert infrared energy to an electrical signal and computer 17 which uses these signals to compute and produce output signals indicative of the

> concentration of CO2 and HC in the vehicle's emission, see col. 6, lines 50-55. Furthermore, Didomenico et al discloses the calculation for emissions wherein results includes the ratios of the CO and HC and CO2 voltages and the data are further analyzed by the computer to determine the concentration of each constituent within the exhaust emission, see col. 7, lines 5-13. Didomenico et al. on col. 5, lines 5-29, discloses measurements of occurrence of water interference in gas sample and determines whether occurrence of water interference corresponds to interference condition. Didomenico et al teaches the claimed invention as disclosed, however, the reference does not teach individual HC concentration in gas. Addiego teaches a sensor for selectively detecting HC classes in gas mixture, see col. 6, lines 5-16. Therefore, it would have been obvious to one of the ordinary skill in the art at the time of invention to utilize Addiego into Didomenico et al for the use of sensor for determining HC classes in gas sample, because these measurements provides accurate proportion of hydrocarbon concentration.

The combination of Didomenico et al. and Addiego fails to render the invention as recited in the claims as being unpatentable under 35 U.S.C. §103.

In order to determine obviousness or non-obviousness of patent application claims under 35 U.S.C. § 103, several basic factual inquiries must be made. These factual inquiries are set forth in *Grahm v. John Deere Co.*, 383 U.S. 1, 17, 148 U.S.P.Q. 459, 467 (1996):

> Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined.

In rejecting claims under 35 U.S.C. §103, and Examiner bears an initial burden of presenting a *prima facie* case of obviousness. A prima facie case of obviousness is established only if the teachings of the prior art would have suggested the claimed subject matter to a person of ordinary skill in the art. If an Examiner fails to establish a *prima facie* case, the rejection is improper and will be overturned. See *In re Rijckaert*, 9 F.3d 1531, 28 U.S.P.Q. 2d 1955 (Fed. Cir. 1993). "If examination ... does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to the grant of the patent." *In re Oetiker*, 977 f.2d 1443,

1445-1446, 24 U.S.P.Q. 2d 1443, 1444 (Fed. Cir. 1992). A *prima faci* case of obviousness has not been made in that neither Didomenico et al. nor Addiego taken either alone or in combination, teach or suggest the invention as recited in independent claims 1, 11 and 19 of the present application.

The combination of Didomenico et al. and Addiego fails to teach or suggest the feature of **determining** whether the occurrence of water interference exceeds or corresponds to an interference level or condition as recited in independent claims 1, 11 and 19.

The present invention as recited in the claims **determines** interference from water to validate the hydrocarbon measurements (see page 9, paragraph 18 of the present application). It is argued in the Office Action dated April 15, 2003 that Didomenico et al. teaches this feature as recited in independent claims 1, 11 and 19.

Didomenico et al. at best discloses **eliminating** responses due to a contaminant water by using a center wavelength 104 (shifted away from a characteristic wavelength) with a corresponding bandwidth 105 (see column 5, lines 22-29 of Didomenico et al.). Didomenico et al. fails to teach or suggest **determining** whether the occurrence of water interference exceeds or corresponds to an interference level or condition as recited in independent claims 1, 11 and 19.

It is argued in the final Office Action dated October 6, 2003 on page 2, first paragraph that "Didomenico is in interest of determining the **occurrence** of water interference **corresponds** to an interference level, such as eliminate interference from one or contaminant water, therefore, it has to first determine the occurrence of water interference corresponding to an interference level before eliminating."

Didomenico et al. as stated in the final office Action dated October 6, 2003 does eliminate interference of water. This, however, is not accomplished by **determining** whether the

occurrence of water interference exceeds or corresponds to an interference level or condition as recited in independent claims 1, 11 and 19.

Didomenico et al., instead, teaches how to **avoid** measuring responses due to water interference. This is accomplished by selecting a center wavelength away from the characteristic wavelength so that there is no substantially measurable response due to the contaminant water (see Didomenico et al. column 5, lines 17-29 reproduced below).

> If a detection bandwidth 109 centered about the characteristic wavelength 100 of hydrocarbon is selected, it can be seen that within such a detection bandwidth 109, there will also be a measurable response due to the contaminant water in the area of overlap 107. In order to eliminate this problem, a center wavelength 104 can be selected as 3.45 .mu.m (i.e., shifted away from the characteristic wavelength) with a corresponding detection bandwidth 105 such that within the detection bandwidth 105, hydrocarbon produces a measurable response in the region 106 but, at the same time there is no substantially measurable response due to the contaminant water.

Didomenico et al. is silent with respect to **determining** whether the occurrence of water interference exceeds or corresponds to an interference level or condition as recited in independent claims 1, 11 and 19. There is no mention in Didomenico et al. of even having an **interference level** or **condition** as recited in independent claims 1, 11 and 19. It is, therefore, hard to imagine how Didomenico et al. can teach or suggest the feature of **determining** whether the occurrence of water interference **exceeds** or **corresponds** to an **interference level** or **condition** as recited in independent claims 1, 11 and 19. As shown in FIG. 1 of the present application, at step 24, if the water interference is excessive, the THC measurement is flagged as excessive in step 28. If the water interference is not excessive, a validated THC measurement is reported in step 26.

The combination of Didomenico et al. and Addiego fails to teach or suggest the feature of **determining** whether the occurrence of water interference exceeds or corresponds to an interference level or condition as recited in independent claims 1, 11 and 19.

The present invention as recited in the remaining dependent claims 2-9, 12-18 and 20-22 include the features recited in the independent claims 1, 11 and 19. It is therefore respectfully submitted that dependent claims 1-9, 12-18 and 20-22 are patentable over the cited references for at least the same reasons as argued in response to the rejection of independent claims 1, 11 and 19. It is further submitted that each of the dependent claims include additional features not disclosed in Didomenico or Addiego either taken alone or in combination.

X. CONCLUSION

For all of the above-noted reasons, it is strongly contended that certain, clear and important distinctions exist between the present invention as recited in claims 1-22 and the cited references as provided in the Office Action. It is further contended that these distinctions are more than sufficient to render the claimed invention unobvious to a person of ordinary skill in the art at the time the invention was made.

This final rejection being in error, therefore, it is respectfully requested that this Honorable Board of Patent Appeals and Interferences reverse the Examiner's decision in this case, and indicate the allowability of claims 1-22.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fee deficiencies or credit any overpayments to Deposit Account No. 50-2036.

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APPENDIX 1

1. (Original) A method of measuring hydrocarbon content in a gas, comprising:

measuring a plurality of individual hydrocarbon concentrations in a gas sample;

determining a total concentration based on the plurality of individual concentrations;

identifying an occurrence of water interference in the gas sample; and

determining whether the occurrence of water interference exceed an interference level.

2. (Original) The method of claim 1, wherein the first determining step comprises:

grouping the individual hydrocarbon concentrations into a plurality of classes;

summing the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and

adding the class concentrations to yield the total concentration.

3. (Original) The method of claim 1 wherein the second determining step determines that the amount of an occurrence of water interference exceeds an interference level, and comprising the additional step of relating the total concentration to water contamination.

4. (Original) The method of claim 1 wherein the second determining step determines whether an omni-state of water amount exceeds an interference level, and further comprising the step of reporting at least one state of matter of water interference condition.

5. (Original) The method of claim 1 wherein the measuring step comprises using an open path emission sensor to detect the intensity of a plurality of infrared spectra in the gas sample.

6. (Original) The method of claim 1 wherein the measuring step comprises measuring by at least one of non-dispersive infrared detection, dispersive infrared detection, non-dispersive ultraviolet detection, dispersive ultraviolet detection, tunable diode laser, non-dispersive visible detection and dispersive visible detection.

7. (Original) The method of claim 1 wherein the measuring step comprises measuring by at least one of differential optical absorption detection and gas filter correlation detection.

8. (Original) The method of claim 1 comprising the additional step of scaling the total concentration to account for optical overlap of individual hydrocarbon species.

9. (Original) The method of claim 1 comprising the additional step of adjusting at least one of the individual hydrocarbon and CO_2 concentrations to account for one or more ambient conditions.

10. (Original) The method of claim 1 comprising the additional step of adjusting the total hydrocarbon concentration to account for one or more ambient conditions.

11. (Original) A system for measuring hydrocarbon content in a gas, comprising:

an emissions sensor capable of detecting a plurality of individual hydrocarbons in a gas sample;

a processor in communication with said emissions sensor; and

a computer-readable carrier in communication with said processor, said computer-readable carrier containing program instructions that instruct the processor to perform the steps of:

receiving data corresponding to a plurality of individual hydrocarbon concentrations in a sample;

determining a total concentration based on the plurality of individual concentrations;

measuring an occurrence of water interference in the gas sample; and

determining whether the occurrence of water interference corresponds to an interference condition.

12. (Original) The system of claim 11 wherein the emissions sensor comprises an open path emissions sensor or a closed path emissions sensor.

13. (Original) The system of claim 11 wherein the program instructions that instruct the processor to perform the first determining step comprise instructions to:

group the individual hydrocarbon concentrations into a plurality of classes;

sum the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and

add the class concentrations to yield the total concentration.

14. (Original) The system of claim 11 further comprising an ambient condition sensor that receives ambient condition data.

15. (Original) The system of claim 14 wherein the program instructions further instruct the processor to adjust the total concentration in response to the ambient condition data.

16. (Original) The system of claim 11 further comprising a transmitter that is capable of transmitting data corresponding to the total concentration.

17. (Original) The system of claim 11 wherein the emissions sensor and the processor are linked by a communications link that allows data corresponding to a plurality of individual hydrocarbon concentrations to be transmitted by the emissions sensor to the processor via the communications link.

18. (Original) The system of claim 11 wherein the program instructions further instruct the processor to, when an omni-state of water occurrence corresponds to an interference condition, relate the total concentration to at least one state of matter of water interference contamination.

19. (Original) A system for measuring hydrocarbon content in a gas, comprising:

a means for detecting a plurality of individual hydrocarbons in a gas sample;

a means for determining a total concentration based on the plurality of individual concentrations;

a means for identifying an occurrence of water interference in the gas sample; and

a means for determining whether said occurrence of water interference correspond to an interference condition.

20. (Original) The system of claim 19 wherein the means for determining a total concentration comprises:

a means for grouping the individual hydrocarbon concentrations into a plurality of classes;

a means for summing the individual hydrocarbon concentrations within each of the plurality of classes to yield a plurality of class concentrations; and

a means for adding the class concentrations to yield the total concentration.

21. (Original) The system of claim 19 further comprising:

a means for detecting one or more ambient conditions; and

a means for adjusting gas measurements to account for one or more ambient conditions.

22. (Original) The system of claim 19 further comprising:

a means for scaling gas measurements to account for multiple counting of individual hydrocarbon species;

a means for adjusting at least one of the individual hydrocarbon and CO_2 concentrations to account for one or more ambient conditions; and

a means for adjusting the total hydrocarbon concentration to account for one or more ambient conditions.